CALIFORNIA ENERGY COMMISSION

New Solar Homes Partnership

Technical Procedures
Eligible Systems and Specifications
Expected Performance-Based Incentives

Bill Pennington

Manager, Buildings and Appliances Office,

Efficiency, Renewables and Demand Analysis Division

Technical Development Team

- California Energy Commission
  - Bill Pennington
  - Smita Gupta
- 2008 Title 24 Update Consultants
  - Charles Eley
  - Bruce Wilcox
- PV software tool – contractor
  - Dr. William Beckman,
    University of Wisconsin - Solar Energy Lab
- PV technical advisors – KEMA contractors
  - Bill Brooks
  - Chuck Whitaker
  - Tom Hoff
  - Jeff Newmiller

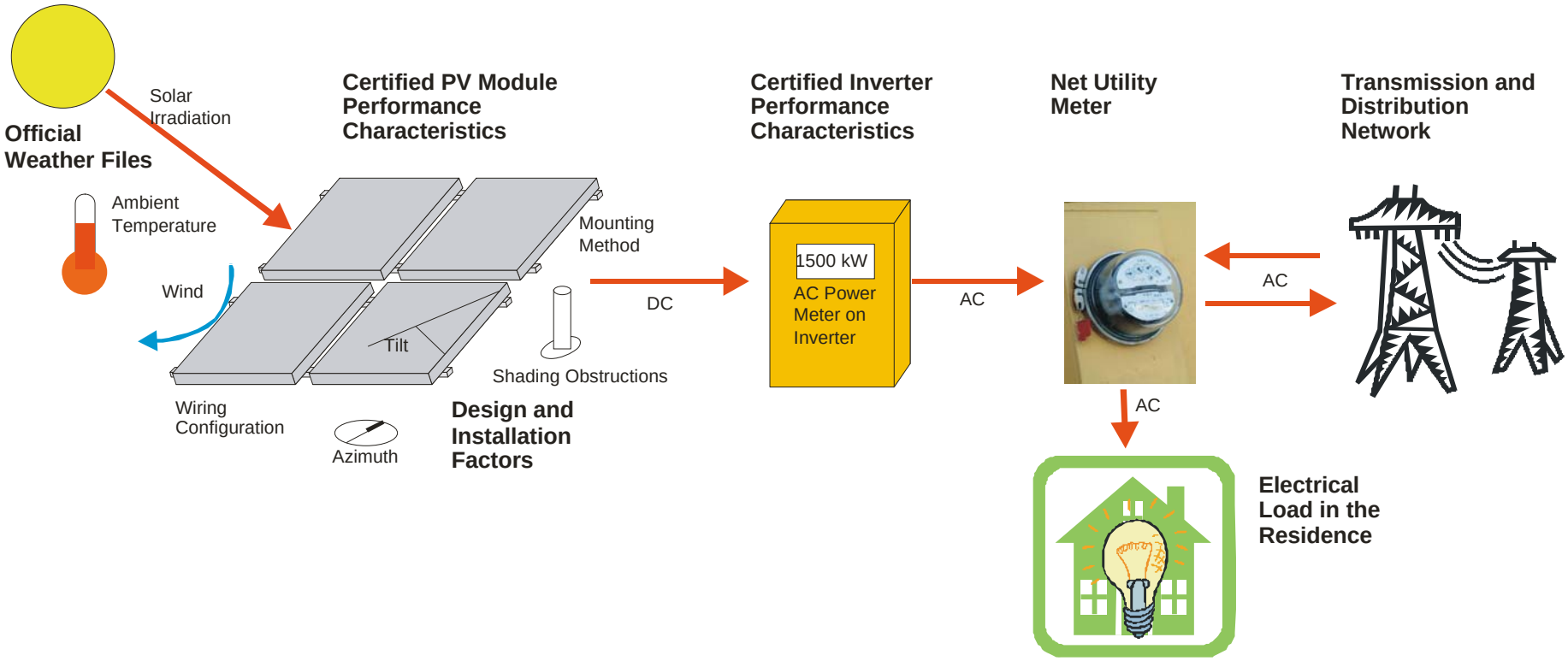
Related IEPR Policy Principles

- Promote high performing systems that result in cost-effective public funding (in terms of long-term energy generation per $ of incentives)
- Target PV installations to climate zones with high peak demand for air conditioning and where PVs will have most benefit to the grid
- Establish a performance-based incentive structure
- Leverage energy efficiency improvements while deploying photovoltaics, integrating high energy efficiency and considering time-of-use energy
- Incorporate PVs into the 2008 Building Energy Efficiency Standards

Extend Building Standards Methods

- Use the performance based compliance software approach of the building energy standards to impact performance and optimize design and installation of PV systems
- Use third party inspection for PV systems similar to the quality installation inspection of energy efficiency features to avoid construction defects, builder liability and customer satisfaction
- Use a component certification program approach similar to product certification programs for appliances, windows (NFRC), cool roof products (CRRC)
- Use the Commission adopted approach of TDV Energy to place energy efficiency and generation priority on hot, high demand, high growth, high system cost areas

PV Performance Calculations



Calculator Interface

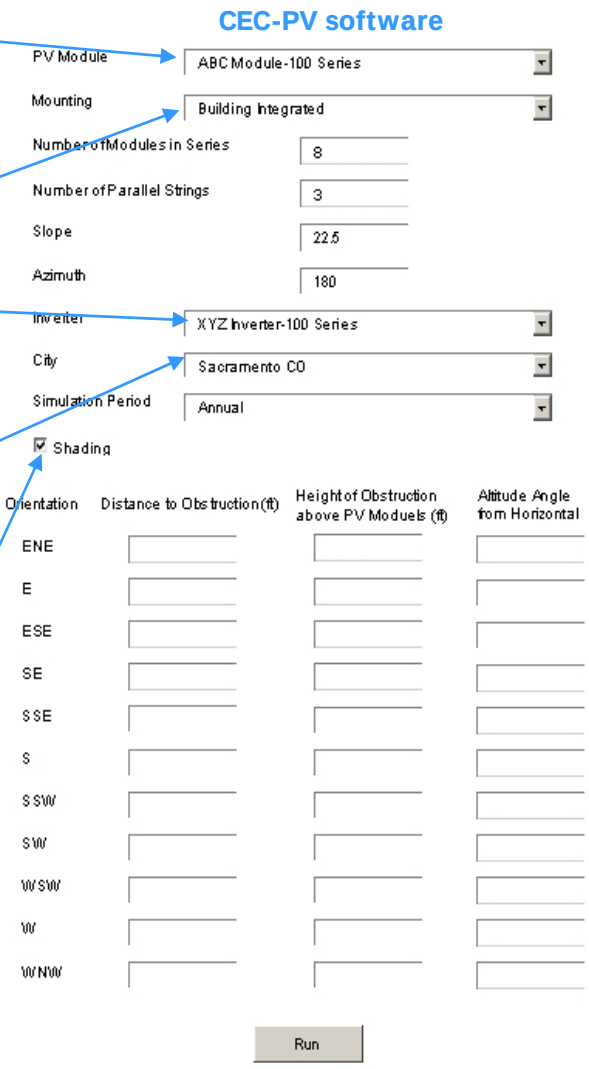
Choose from list of CEC certified PV modules (tested input values)

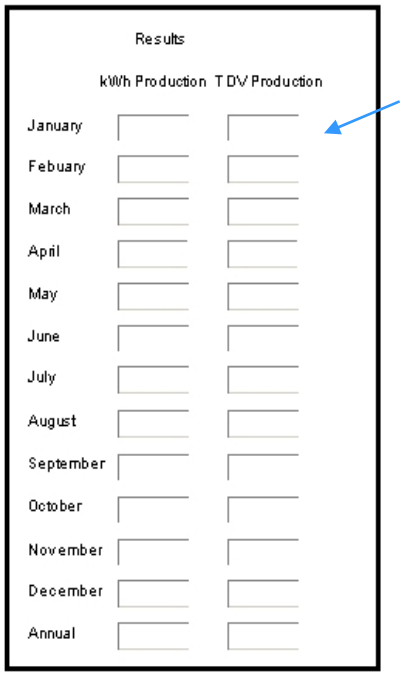
Mounting method affects the temperature of the PV module

Choose from list of CEC certified inverters (tested input values)

Choose a city from Standards list (CZ weather file)

Check this box if the PV array is partially shaded. When checked user will enter more data.

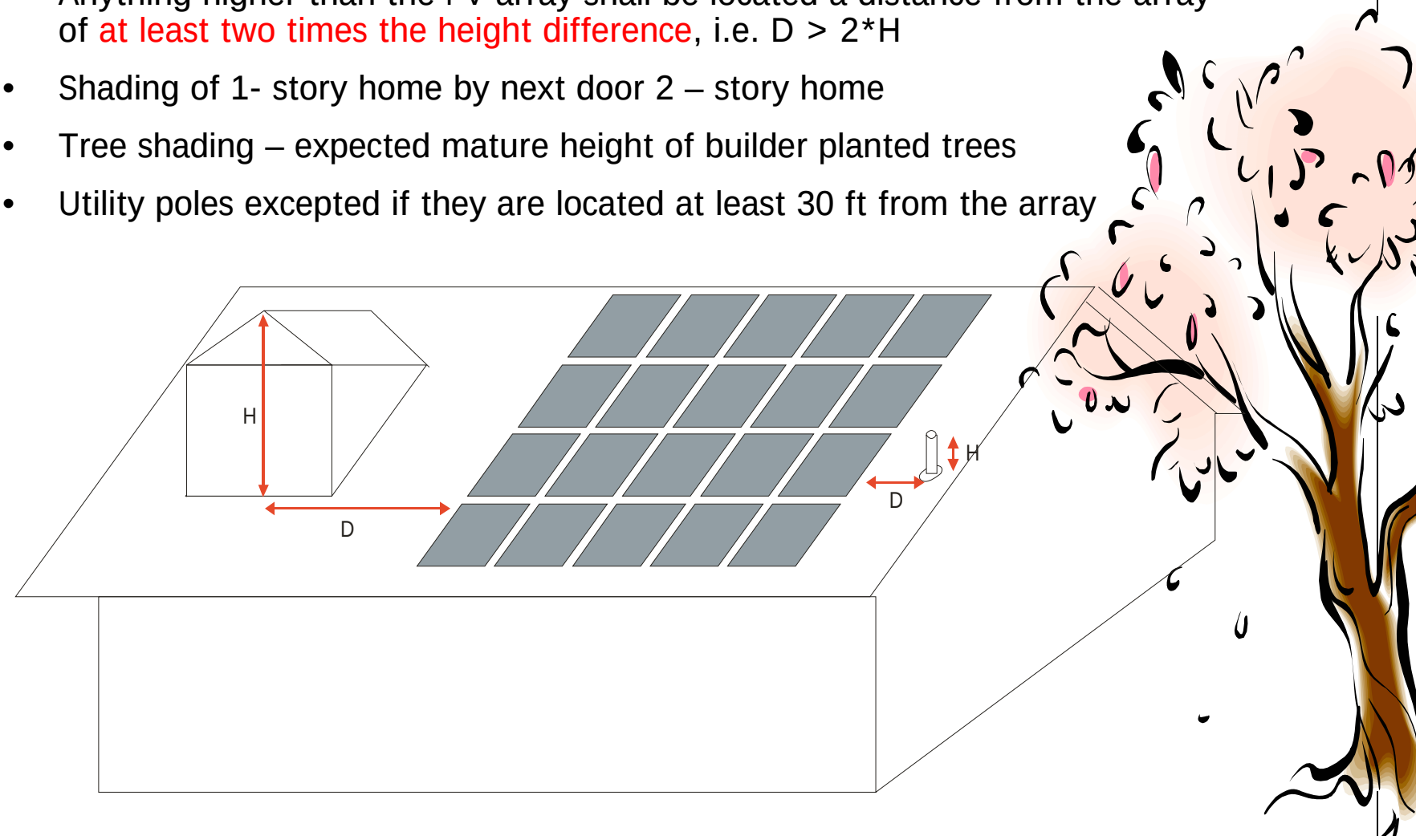




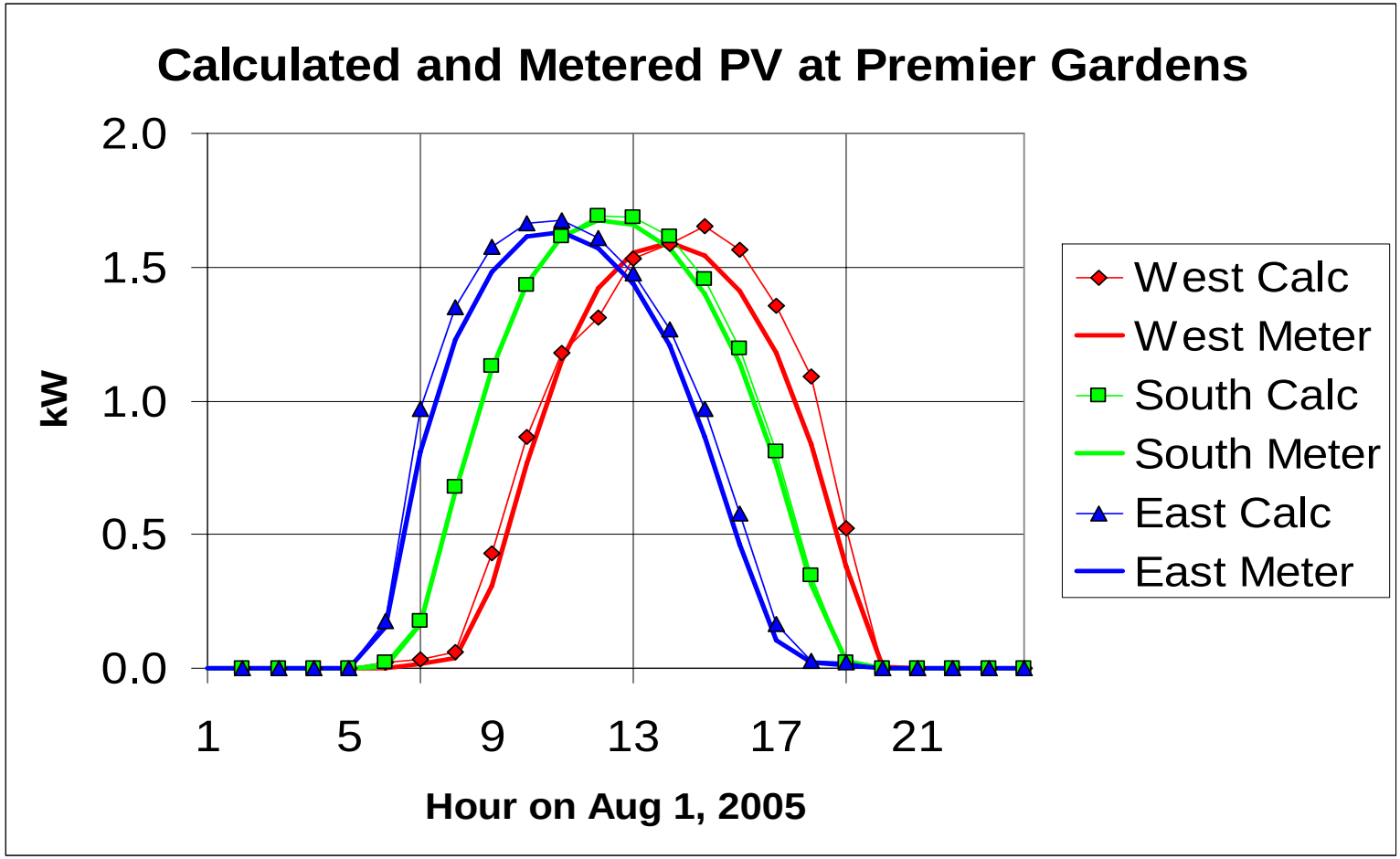
Example results

The "No Shading" Criterion

- Anything higher than the PV array shall be located a distance from the array of at least two times the height difference, i.e. D > 2*H
- Shading of 1- story home by next door 2 – story home
- Tree shading – expected mature height of builder planted trees
- Utility poles excepted if they are located at least 30 ft from the array



Validation of model



48 - GE BIPV 55W each panels

SMA 2500 inverter

Certification

- PV Module
  - Inputs to performance calculator to be certified (V_{mp}, I_{mp}, V_{oc}, I_{sc}, temperature coefficients at STC conditions and the installed NOCT at specified conditions)
  - Values now are routinely available through manufacturers (but not certified)
  - Possible Commission-approved administration mechanism like NFRC and CRRC (Powermark or other)
  - Specify tests (ASTM E 1036) and laboratory verification requirements
- Inverter – Sandia test protocol
  - Current ERP eligibility criteria
  - Use the tested values (efficiency at various operation conditions of voltage and power) in inverter modeling

Field Verification Process

- Same process used for field verification for energy efficiency for Title 24, New Construction programs, Energy Star, Federal Tax Credits
- Installer tests and certifies every system
- HERS raters verify and test a sample of systems
  - under contract to the builders (value-added quality control service) and
  - under the oversight of HERS providers (CHEERS, CalCERTS, CBPCA – over 1,000 HERS raters statewide)
- Commission develops field verification protocols (appendices to Guidebook and Standards)
- Commission insures that HERS Providers develop training curriculum to train HERS Raters

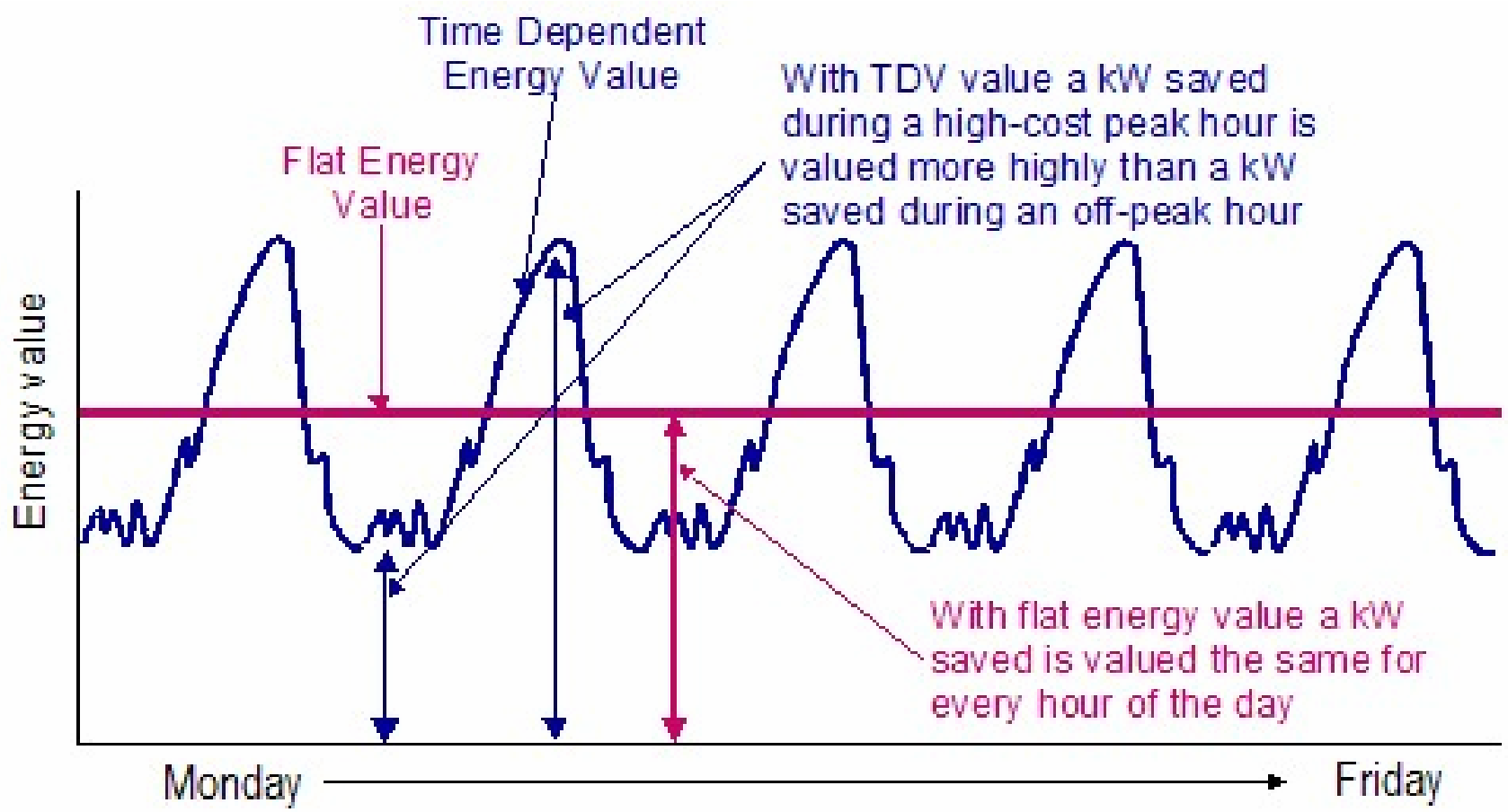
Field Verification Tasks

- Visual Inspection
  - Verify that installed equipment (modules and inverter) are the same as specified
  - Verify that the installation (orientation, tilt, etc.) is the same as specified
- Shading Evaluation
  - Check for "no shading" criterion
  - Check for shading obstructions included in the calculations
  - Check for trees expected to shade modules at maturity
- Performance Verification
  - Measure solar irradiation and ambient temperature
  - Look up the expected output for the measured conditions on the table generated by the CEC-PV software
  - Verify AC output displayed on the inverter is as expected

Expected AC output for verification

Solar Irradiance (W/m²)	Ambient Temperature										
	Centigrade	-1	4	10	16	21	27	32	38	49	60
	Farenheit	30	40	50	60	70	80	90	100	120	140
1300		2.60	2.60	2.60	2.60	2.60	2.45	2.11	1.89	1.64	1.39
1250		2.60	2.60	2.60	2.60	2.60	2.45	2.04	1.85	1.50	1.34
1200		2.60	2.60	2.60	2.60	2.60	2.44	1.98	1.82	1.47	1.32
1150		2.60	2.60	2.60	2.60	2.60	2.44	1.91	1.80	1.46	1.29
1100		2.50	2.50	2.50	2.50	2.50	2.32	1.85	1.77	1.45	1.27
1050		2.50	2.50	2.50	2.50	2.50	2.19	1.78	1.75	1.44	1.24
1000		2.50	2.50	2.50	2.50	2.50	2.07	1.72	1.71	1.43	1.22
950		2.50	2.45	2.40	2.35	2.30	1.94	1.65	1.70	1.42	1.19
900		2.40	2.40	2.30	2.20	2.10	1.82	1.60	1.60	1.41	1.17
850		2.20	1.98	1.95	1.90	1.90	1.70	1.50	1.50	1.40	1.15
800		2.00	1.95	1.88	1.78	1.70	1.55	1.45	1.40	1.30	1.10
750		1.70	1.65	1.60	1.55	1.50	1.45	1.40	1.30	1.20	1.10

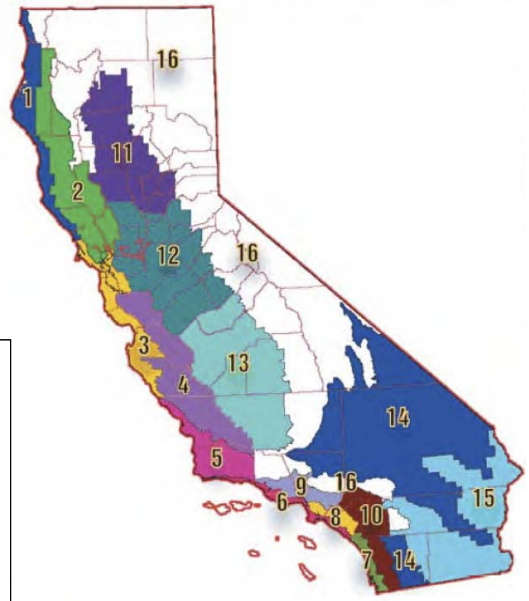
TDV (Time Dependent Valued) Energy



TDV (Time Dependent Valued) Energy

- Adopted by the Commission for the 2005 Building Energy Efficiency Standards (TDV also used by the CPUC for 2006-08 energy efficiency program planning)
- Places time-of-use weighting on energy during peak periods
- Accounts for variation in marginal electricity generation, transmission and distribution (T&D) costs by region
- California's sunniest climates correspond to climates with hottest summers, highest peak demand, greatest housing starts;

Production By Climate Zone



Arcata – CZ1

Sacramento – CZ12

Palm Springs – CZ15

Expected Performance Based Incentives (EPBI)

- Incentives Based on PV Performance Calculator with TDV Place Priority on High production in sunnier climates
  - Higher incentives in high peak load, high growth, high T&D cost areas
  - Higher incentives for efficient PV modules and inverters
  - Lower incentives for partially shaded arrays, poor orientation or tilt
- Commission defines reference system/location
- Performance calculator used to determine expected performance of actual system/location and compare to the reference to determine the incentive

Reference PV system and parameters

Parameters	Reference
Location	Sacramento (latitude, longitude, weather file and TDV)
Azimuth	South (180 deg)
Tilt	5:12 pitch (22.5 deg)
Mounting	BIPV
PV Modules	Premier Gardens system as the reference
Number of modules	
String (series and parallel)	
Inverter	
Shading	None
Default losses	Dirt dust and mismatched wiring (0.88)

Consumer and Builder information

- Verification protocols would be used by builders as bid specifications for installers
- Expected performance table to builder and home owner
- Guidelines for proper tree planting in solar subdivisions to home owner and builder (could be CC&R requirement for subdivisions)
- Commission makes training available on all of this information
- Provides videos for installers and HERS Raters